FINAL
SAMPLING AND ANALYSIS PLAN
RADIOLOGICAL BACKGROUND STUDY
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

Prepared for:

U.S. Environmental Protection Agency Region 9
75 Hawthorne Street
San Francisco, California 94105

U.S. EPA Contract Number: EP-S3-07-05
Work Assignment Number: 021TATA09QL

August 2009

HydroGeoLogic, Inc

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LIST OF ATTACHMENTS

Attachment 1 Field Sampling Plan
Attachment 2 Quality Assurance Program Plan

LIST OF ACRONYMS AND ABBREVIATIONS

ACME	Aerospace Cancer Museum of Education
APTF	Advanced Propulsion Test Facility
ATSDR	Agency for Toxic Substances and Disease Registry
Boeing	The Boeing Company
DOE	U.S. Department of Energy
DTL	distance test locations
DTSC	Department of Toxic Substances Control
EPA	U.S. Environmental Protection Agency
ESG	Energy Systems Group
ETEC	Energy Technology Engineering Center
FSP	Field Sampling Plan
HGL	HydroGeoLogic, Inc.
HSA	Historical Site Assessment
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
NASA	National Aeronautics and Space Administration
NPDES	National Pollutant Discharge Elimination System
QAPP	Quality Assurance Project Plan
RMHF	Radioactive Materials Handling Facility
RBRA	radiological background reference area
SAP	Sampling and Analysis Plan
SRE	Sodium Reactor Experiment
SSFL	Santa Susana Field Laboratory
WA	Work Assignment

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1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) describes the technical assistance activities to be performed on behalf of the U.S. Environmental Protection Agency (EPA) by HydroGeoLogic, Inc. (HGL), during the radiological background study for the Santa Susana Field Laboratory (SSFL) site located near Ventura County, California. The SSFL site location is illustrated on Figure 1.1. This technical assistance task is being executed under EPA Contract Number EP-S3-07-05, Work Assignment (WA) 021TATA09QL.

The SAP is composed of two parts: Attachment 1 is the Field Sampling Plan (FSP) and Attachment 2 is the Quality Assurance Project Plan (QAPP). The roles and responsibilities of the HGL team, which includes members from The Palladino Company Inc., are described in Section 1.1 of the QAPP. A site-specific Health and Safety Plan will be submitted to EPA under separate cover.

During the preparation of these planning documents, site stakeholders participated in the development technical approach and in the process of selecting optimal sampling locations. HGL acknowledges the valuable contribution of the Aerospace Cancer Museum for Education (ACME), Bridge the Gap, and other community members in designing the radiological background study.

1.1 OBJECTIVES

The primary objective of the SSFL radiological background study is to determine background radionuclide concentrations within surface and subsurface soils overlying the two geologic formations that are present at the SSFL (Chatsworth and Santa Susana Formation). The potential uses of the data generated from this study include the following:

- Determine the extent of soil contamination at the SSFL;
- Assist the California Department of Toxic Substances Control (DTSC) in establishing appropriate cleanup levels;
- Provide background data to be used in human health and ecological risk assessments; and
- Establish a reference data set for site characterization surveys and site closure surveys (final status surveys) in accordance with Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) guidance.

To accomplish this primary objective, surface and subsurface soil samples will be collected at three radiological background reference areas (RBRAs) located outside the SSFL property boundary. Two of the areas overlie the Chatsworth Formation and one area overlies the Santa Susana Formation. The RBRAs that overlie the Chatsworth Formation are known as the Lang Ranch Location (which is located within China Flat on National Park Service land) and the Rocky Peak Location; and the RBRA that overlies the Santa Susana Formation is known as the Bridle Path Location. RBRAs were selected and approved by the EPA, with the concurrence of the project stakeholders participating in the Background Study Technical Group, which consists of community members and other stakeholders. All three are located between three and six miles from the SSFL property boundary (see Figure 1.2). Figures 1.3 through 1.5 illustrate the locations of the RBRA sampling locations. The process that was followed to select these RBRAs is described in Section 1.3 of the FSP.

During Background Study Technical Group meetings, community members expressed concern that the proposed RBRAs may be too close to the SSFL and may have been impacted by atmospheric releases of radionuclides from SSFL. It was postulated that the deposition of radionuclides from historic releases may have artificially increased radionuclide concentrations in surface soils at the proposed RBRAs. If this is the case, then the radionuclide concentrations in surface soils would not reflect background conditions. To address this concern, a secondary study was designed to determine whether surface soils at the RBRAs have been impacted by SSFL releases.

To accomplish this secondary objective, surface soil samples will be collected in areas that are located greater than 10 miles from the SSFL. These locations are referred to as distance test locations (DTL). Surface soil samples will be collected and analyzed at 20 of the DTLs identified on Figure 1.6 (for example: five in each quadrant). These samples will be analyzed for a targeted group of radionuclides, which could likely be found in SSFL atmospheric releases. Surface soil samples will also be collected at the three RBRAs and analyzed for the same targeted list of radionuclides. A statistical analysis will be conducted to determine whether the radionuclide concentrations in surface soil at the individual RBRAs are higher than the radionuclide concentrations at the DTLs.

1.2 SCOPE OF WORK

In accordance with the approved WA scope, HGL will complete the following activities in order to accomplish the objectives described above:

- Conduct surface soil sampling at RBRAs and DTLs;
- Perform statistical evaluation of radionuclide concentrations in surface soils at the DTLs and the proposed RBRAs to determine whether the RBRAs have been impacted by releases from the SSFL;
- Complete a surface soil gross gamma survey at the DTLs and RBRAs;
- Conduct subsurface soil sampling at the RBRAs;
- Conduct gamma surveys of boreholes;

- Validate the analytical data to determine its usability for decision making; and
- Prepare a report summarizing field activities and analytical data.

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2.0 SITE BACKGROUND

This section describes the SSFL, geologic formations scheduled to be sampled during the study, and site history. The site history section is a very brief overview of the SSFL obtained from various EPA and non-EPA documents. Information in this section is subject to change upon completion of the EPA's Historical Site Assessment (HSA).

2.1 SITE LOCATION AND DESCRIPTION

The SSFL is located in southeastern Ventura County, CA, near Simi Valley. The 2,850-acre site is approximately 30 miles northwest of downtown Los Angeles between the Simi and San Fernando Valleys in the Simi Hills. Residential areas are near the southern, northern, and eastern boundaries of the site. The geographic coordinates from the central portion of the Site are 39º, 13', 51" north latitude and 118º, 41', 47" west longitude.

The site is divided into four administrative areas (I, II, III, and IV) and undeveloped buffer properties to the northwest and south as described below [Agency for Toxic Substances and Disease Registry (ATSDR), 1999]:

- Area I consists of 671 acres owned by The Boeing Company (Boeing) and 42 acres owned by National Aeronautics and Space Administration (NASA) (formerly owned by the U.S. Air Force) in the northeast portion of the Site. Area I contains administrative and laboratory facilities and was formerly used for rocket engine testing. Area I also includes the former Area I Thermal Treatment Facility and three rocket engine test areas, the Bowl, Canyon, and Advanced Propulsion Test Facility (APTF) areas.
- Area II consists of 410 acres in the north-central portion of the site and is owned by NASA and operated by Boeing. Area II contains four former rocket test firing facilities. Area II includes the Alfa, Bravo, Coca, and Delta rocket engine test areas.
- Area III consists of 114 acres in the northwest portion of the site and is owned and operated by Boeing. Area III includes systems test area (STL-IV) and associated laboratories.
- Area IV consists of 290 acres owned and operated by Boeing; including 90 acres leased by the U.S. Department of Energy (DOE). DOE and its contractors operated several nuclear reactors and associated fuel facilities and laboratories within this area.
- The northwestern and southern buffer zones consist of 182 and 1,143 acres, respectively. Industrial activities have never occurred on these naturally vegetated areas. Boeing purchased the northwestern buffer zone from the American Jewish University's Brandeis-Bardin Campus approximately 10 years ago. The purchase was made in accordance with a legal settlement over contamination of the university's land.

This background study will ultimately support the characterization and cleanup of radionuclides at the SSFL.

2.2 SITE GEOLOGY

Two geologic formations underlie Area IV within the SSFL: the Chatsworth Formation and the Santa Susana Formation. The radiological background study focuses on characterizing the soils at the background reference locations overlying these formations. A description of these geologic formations is provided below. The descriptions were derived from the Geologic Map of the Calabasas Quadrangle by Thomas W. Dibblee, Jr. (1992).

2.2.1 Chatsworth Formation

The Chatsworth Formation consists of three unnamed members. The members were deposited in the deep ocean at depths that ranged from 4,000 to 5,000 feet by turbidity currents, which are massive submarine landslides, from the continental shelf into submarine canyons. The turbidity currents were generally more than a half-mile wide and greater than 10 miles in length. During the periods without turbidity currents, silt and clay particles from heavy land runoff filtered down to the ocean floor and became siltstone strata found in the formation. The uppermost member is a thick strata of light gray to brown sandstone, which is hard, coherent, arkosic, micaceous, primarily medium grained separated by thin partings of siltstone. The middle member is a gray conglomerate of cobbles of metavolcanic and granitic detritus in hard sandstone matrix. The lower member is gray clay shale, crumbly with ellipsoidal fracture where weathered, and may include sandstone strata.

2.2.2 Santa Susana Formation

The Santa Susana Formation was also formed by turbidity currents and consists of four members. The unnamed uppermost layer of the Santa Susana Formation consists of gray micaceous claystone and siltstone with a limited number of thin sandstone beds. Below the uppermost layer lies a second unnamed layer that is made up of tan coherent fine grained sandstone, which locally contains thin shell-beds and calcareous concretions. Underlying this layer is the Las Virgenes Sandstone Member, which is composed of tan semi-friable bedded sandstone and is locally pebbly. The oldest member is the Simi Conglomerate Member. This member contains gray to brown cobble conglomerate with smooth cobbles of quartzite, metavolcanic and granitic rocks in sandstone matrix that locally includes thin lenses of red clay.

2.3 SITE HISTORY

A brief summary of the SSFL property ownership, activities and facilities associated with Area IV of the SSFL site is provided in this section.

2.3.1 SSFL Property Ownership

In the late 1940s, the SSFL site property was purchased by North American Aviation. Atomics International, a division of North American Aviation from 1955 to 1984, set aside a part of Area IV for nuclear reactor development and testing. In 1984, Rocketdyne, a division of Rockwell, absorbed Atomics International. Boeing subsequently purchased Rockwell in 1996, and Rocketdyne remains a division of Boeing. Currently, the SSFL site property is

jointly owned by Boeing and NASA, and is operated by Boeing. A portion of the property owned by Boeing is leased to DOE (ATSDR, 1999).

2.3.2 Radiological Facilities

During its peak operation, the ETEC consisted of 272 numbered structures. Most of the buildings were demolished, once their mission was achieved. Many facilities were decontaminated, decommissioned, and demolished after the ETEC was deactivated in 1996. In 2009, 23 structures currently remain.

2.3.3 Radiological Activities

From the mid-1950s until 1964, activities at the SSFL primarily focused on developing a sodium-cooled nuclear power plant, and developing space power systems with sodium and sodium/potassium coolants. The ETEC was formed in the mid-1960s as an Atomic Energy Commission laboratory for the development of liquid metal heat transfer systems in support of the Liquid Metal Fast Breeder Reactor Program. The Atomic Energy Commission was one of the predecessor agencies to DOE. The ETEC nuclear operations included:

- ten nuclear research reactors,
- seven criticality facilities,
- burn pits,
- the hot laboratory,
- the nuclear materials development facility (plutonium fuel fabrication facility),
- the Radioactive Materials Handling Facility (RMHF), and
- various test and nuclear material storage areas.

Historical operations at the SSFL have resulted in the release of radionuclides and other contaminants to the environment. A widely known incident that resulted in a measurable release was the Sodium Reactor Experiment (SRE) Fuel Damage incident. The SRE was a liquid-sodium-cooled 20 megawatt reactor that was moderated by graphite and was part of an Atomic Energy Commission program focused on demonstrating the feasibility of a high-temperature, sodium cooled power reactor for civilian application. A power excursion was documented at the SRE during this experiment on July 13, 1959. The SRE operated intermittently until July 26, 1959 when operation was ceased to inspect the rods. A clogged coolant channel had resulted in localized melting of 30 percent of the fuel elements in the reactor core. The fuel elements fell to the bottom of the primary sodium containment vessel and the reactor was shut down (McLaren/Hart, 1993). As a result of this incident, gas containing radionuclides built up within the reactor; which eventually released gases into the atmosphere. In addition, a burn pit was also used from 1966 to the late 1970s for the disposal of metallic sodium and sodium-potassium mixtures, solvents, and radioactively-contaminated equipment. These activities also led to the release of radiological contaminants to the environment.

The Draft Gap Analysis Report produced by CDM Inc., submitted on June 1, 2008, listed incidents that may have released the following radionuclide's: Am-241, Co-60, Cs-134, Cs-137, Eu-152, Eu-154, Fe-59, H-3, K-40, Kr-85, Mn-54, Pm-147, Pu-238, Pu-239, Sr-90, Th-232, U-234, U-235 and U-238.

Planning is currently underway to conduct a detailed investigation of radiological contamination at the SSFL. This study is being led by the U.S. EPA Region 9, and field activities are scheduled to begin in the fall of 2009.

3.0 ORGANIZATION OF THE SAMPLING AND ANALYSIS PLAN

This SAP is composed of the following sections:

Section 1 – Introduction
Section 2 – Site Background
Section 3 – Organization of the Sampling and Analysis Plan
Section 4 – References

Attachment 1: Field Sampling Plan

Section 1 – Radiological Background Study Program
Section 2 – Field Activity Methods and Procedures
Section 3 – Investigation-Derived Waste Management
Section 4 – References

Attachment 2: Quality Assurance Project Plan

Section 1 – Project Management
Section 2 – Measurement and Data Acquisition
Section 3 – Assessment and Oversight
Section 4 – Data Validation Requirements and Usability
Section 5 – Data Management and Visualization
Section 6 – References

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4.0 REFERENCES

Agency for Toxic Substances and Disease Registry (ATSDR), 1999. *Draft Preliminary Site Evaluation of the Santa Susana Field Laboratory. Ventura, CA.* December.

McClaren/Hart, 1993. *Multi-Media Sampling Report for the Brandeis-Bardin Institute and the Santa Monica Mountains Conservancy*. Volume I. 1993.

U.S. Department of Energy (DOE), 2003. *Environmental Assessment for Cleanup and Closure of the Energy Technology Engineering Center, Final*. Oakland, CA. March.

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FIGURES

Figure 1.1
Site Location
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

Santa Susana Field Laboratory Property Boundary

N

Buffer Zone
AREA II
AREA I
AREA IV
AREA III
Buffer Zone
Simi Valley
Bard Reservoir
Chatsworth Reservoir
Los Angeles
Thousand Oaks
Agoura Hills
Westlake Village
Calabasas
118
23
27
5
405
101
0 0.5 1 2
Scale In Miles

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Project: E10021
Created: CLimoges 20090605
Revised:
Source: CaSil, NAIP 2005

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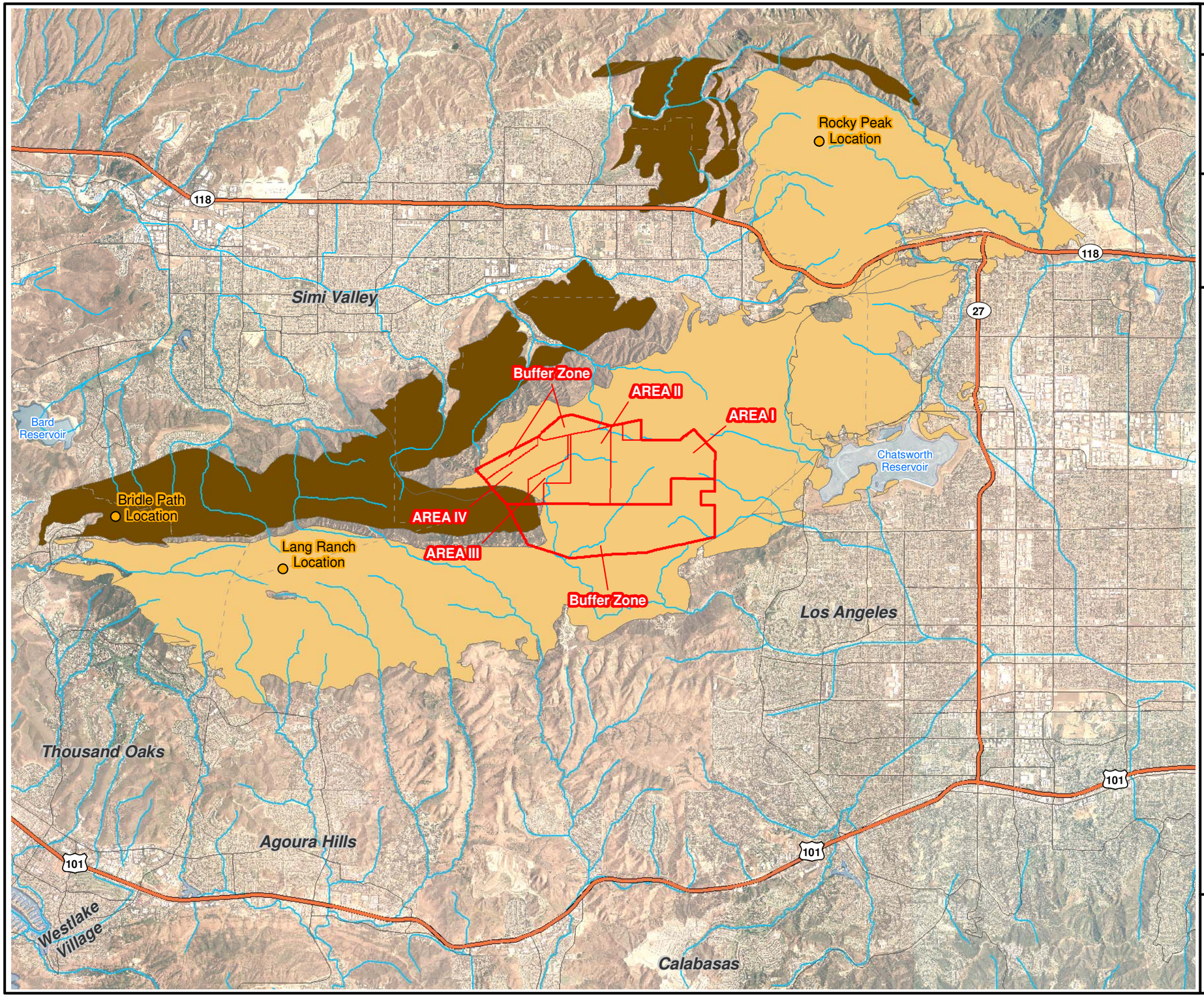
Figure 1.2
Radiological Background Reference Area Locations

U.S. EPA Region 9



Legend

- Background Locations
- Santa Susana Field Laboratory Property Boundary
- Surface Water

Geology

- Chatsworth Formation
- Santa Susana Formation

N

0 0.5 1 2

Scale In Miles

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Revised: CLimoges 20090811
Source: CaSil, NAIP 2005

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Figure 1.3
Bridle Path Radiological Background Reference Area Conceptual Sampling Grid

U.S. EPA Region 9

Legend

- Bridle Path Background Location
- Soil Sampling Location
- Approximate Location of Radiological Background Reference Area
- Intermittent Stream
- City Boundary

Notes:
Inset depicts conceptual sampling grid. Each point is equidistant (31.7 feet) from the other.

N

0 250 500 1000
Scale In Feet

Filepath: X:/EPA010/Santa_Susana_Field_Lab/Maps/SAP (3)BridlePath_Map.mxd
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Revised: CLimoges 20090713
Source: USGS, September 2007

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Figure 1.4
Lang Ranch Radiological Background Reference Area Conceptual Sampling Grid

U.S. EPA Region 9

Legend

- Lang Ranch Background Location
- Soil Sampling Location
- Approximate Location of Radiological Background Reference Area
- Intermittent Stream
- City Boundary

Notes:
Inset depicts conceptual sampling grid. Each point is equidistant (31.7 feet) from the other.

N

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Scale In Feet

Filepath: X:/EPA010/Santa_Susana_Field_Lab/Maps/SAP (4)LangRanch_Map.mxd
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Source: USGS, September 2007

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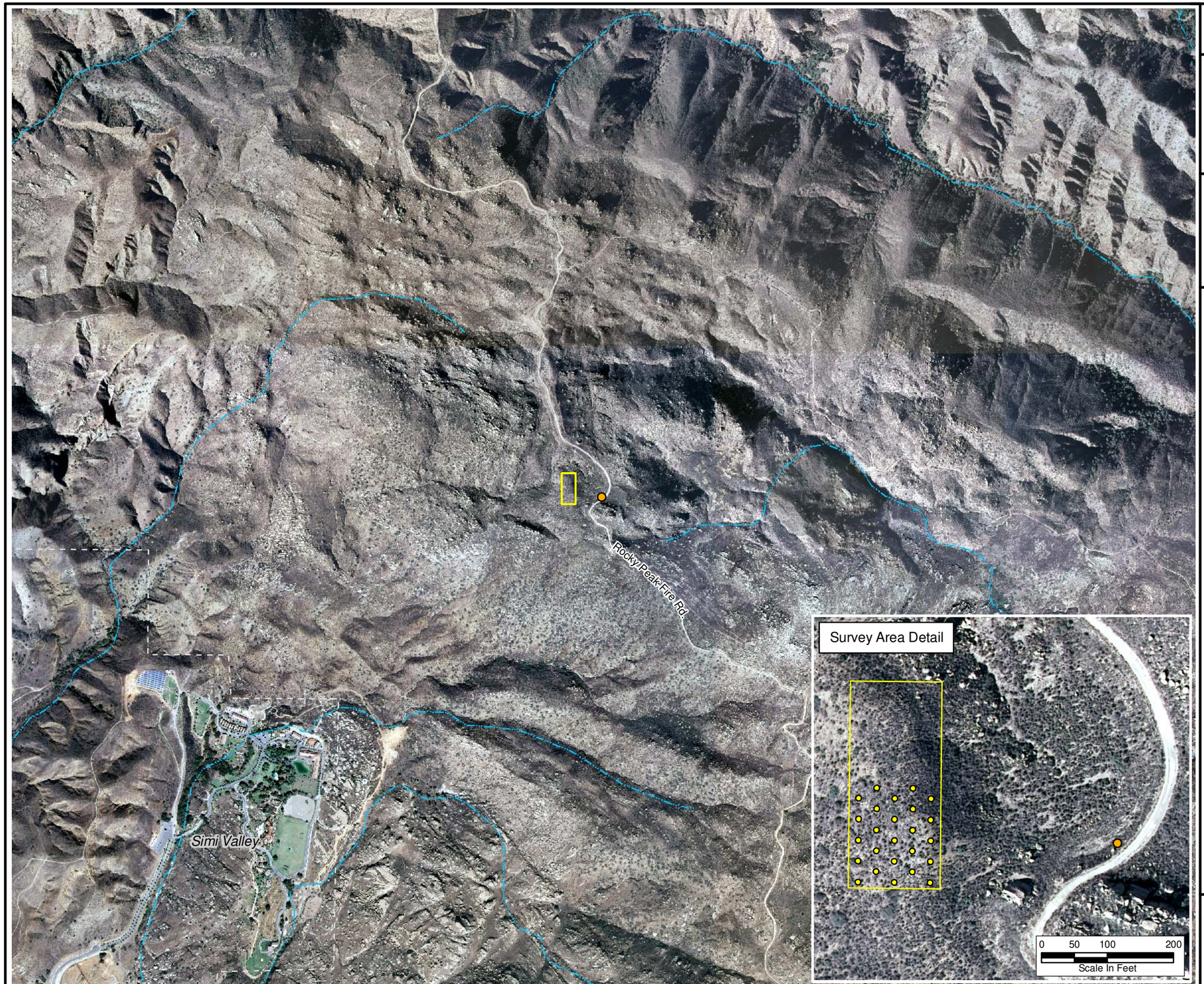
Figure 1.5
Rocky Peak Radiological Background Reference Area Conceptual Sampling Grid

U.S. EPA Region 9



Legend

- Rocky Peak Background Location
- Soil Sampling Location
- Approximate Location of Radiological Background Reference Area
- Intermittent Stream
- City Boundary

Notes:
Inset depicts conceptual sampling grid. Each point is equidistant (31.7 feet) from the other.

N

0 250 500 1000
Scale In Feet

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Revised: CLimoges 20090713
Source: USGS, January 2006; September 2007

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Figure 1.6
Distance Test Location Map

U.S. EPA Region 9

Legend

- Distance Test Locations
- Santa Susana Field Laboratory Property Boundary
- Parks

Geology

- Chatsworth Formation
- Santa Susana Formation

N

0 1 2 4

Scale In Miles

Filepath: X:/EPA010/Santa_Susana_Field_Lab/Maps/SAP/(06)DTLs_Overview.mxd
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Created: CLimoges 20090607
Revised: CLimoges 20090811
Source: CaSil, NAIP 2005

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ATTACHMENT 1

FIELD SAMPLING PLAN

ATTACHMENT 2

QUALITY ASSURANCE PROJECT PLAN